Chapter 12
Intelligent Routing Scheme for FANET Using Bio-Inspired Optimisation

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ABSTRACT

An unmanned aerial vehicle (UAV) is an aircraft without a human pilot that is operated remotely. When multiple UAVs are connected together for performing specific task, the arrangement is called a flying adhoc network (FANET). In a multi-UAV system, communication and coordination among the flying nodes are essential to carry out the mission properly. As the flying nodes are highly dynamic in nature, an efficient routing strategy is important. The intelligent routing decisions in this scenario can be taken by applying bio-inspired optimisation algorithms. This chapter focuses on bio-inspired optimisation techniques for the FANET.

1. INTRODUCTION

Bio-inspired optimization algorithms play a vital role in solving various problems related to decision making, information handling and optimization in the field of science and engineering (Radoglou-Grammatikis et al., 2020). The bio-inspired optimization algorithms are flexible, easily testable, intelligent and improved to solve complex optimization problems. These algorithms can be applied to a variety of problems without much change in the structure of the algorithm. The biological behavior of a group of insects, animals or birds is called swarm intelligence (Oubbati et al., 2017). The swarm intelligence includes division of labor, self-organization and coordination among the herds. This has attracted many researchers to find out solutions for several engineering and science problems (Vrchota et al., 2022).

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The swarm of birds or animals can be compared to a group of Unmanned Aerial Vehicles (UAVs) in the Flying Adhoc Network (FANET) environment. The flying UAVs are used in various applications. They are used for reconnaissance in the military operation (Lytos et al., 2020). A group of UAVs can be launched for crop monitoring in agriculture. In case of natural disasters, UAVs are deployed for recovery operations. Finding an optimal path between these UAVs is essential in the FANET (Wheeb et al., 2022). Several routing protocols are proposed for communication among UAVs in the literature (Rahmani et al., 2022). However, selection of a suitable routing protocol is very important for the proper communication and coordination among the UAVs (Sang, Wu, Xing, & Xie, 2020). High mobility, dynamic changes in the topology and energy requirements of nodes are to be considered when selecting a suitable routing protocol for FANET (Nadeem et al., 2018). Hence the routing protocol can be made efficient by invoking a suitable bio-inspired optimization algorithm (Lakew et al., 2020).

In this paper, a comprehensive analysis of routing protocols suitable for the FANET is done. The rest of the paper is organised as follows: Section 2 presents the related work. Section 3 presents various routing protocols for FANET. Section 4 provides various applications of FANET. Section 5 concludes this paper.

2. RELATED WORK

Rahmani et al. (2022) proposed a new routing method named OLSR+ which is based on fuzzy logic in FANETs. In this paper, the optimized link state routing protocol (OLSR) is improved using a fuzzy logic-based routing scheme. This work aims to improve the routing protocol by various approaches. It estimates the link lifetime based on several factors. It uses the fuzzy mechanism to deal with multipoint relays. This work also involves discovering network topology and calculating routing tables. Radoglou-Grammatikis et al. (2020) present a survey that mainly focuses on various applications of UAVs for precision agriculture. This paper lists out twenty different applications in the precision agriculture domain. The UAV architecture, characteristics and various methodologies adopted are also analysed in detail. Oubbati et al. (2017) proposed a survey on position-based routing protocols for FANETs. This paper also performs a comparative study of the various routing protocols based on their properties, routing metrics and drawbacks.

Vrchota et al. (2022) presented the application of precision agriculture techniques for crops and livestock in the Czech Republic. The research used a questionnaire survey to obtain the result and it showed that crops use the precision agriculture technique more than livestock production. Lytos et al. (2020) present a survey on the exploitation of big data for smart farming. It gives a detailed analysis of the evolution of the agricultural system and also provides details on the sources of information. This paper focuses on the utilization of big data for enhancing agricultural operations. Wheeb et al. (2022) present a review on topology-based routing protocols and mobility models for FANETs. The research work identifies the application categories of UAVs like surveillance and monitoring, search and rescue operations, Military and enforcement operations, 5G and beyond communications. The paper describes twenty-two topology-based routing protocols. An extensive comparison of topology-based routing protocols is made to identify the suitable protocol for FANETs.

Sang et al. (2020) made a review on emerging routing protocols for FANETs. The paper gives an overview of various quality of service (QoS) parameters like packet delivery ratio, sequence length, link quality, geographic location, residual energy, buffer state and neighbour information. The paper